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Coping with Drought: Perceptions, Intentions and Decision-Stages of South West England Households

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Abstract

As water supply in England increasingly faces threats of climate change, urbanisation and population growth, there is an imperative for household water users to be more resilient to extremes such as drought. However, since English water users have not traditionally been involved in drought management, there is need for in-depth understanding of perceptions and intentions towards drought management at a household scale to inform policy approaches. This paper fills this gap by investigating the perceptions and intentions of South West England households towards drought and drought coping. A theoretical framework developed through the lens of protection motivation theory and applying the trans-theoretical model, formed the basis of analysis of a survey administered in two communities in Exeter, England. Results indicated that despite low perceived likelihood and consequences of drought in their local area, participants were willing to implement household drought coping measures. Cluster analyses using a k-means clustering algorithm, found that participants were generally segmented in two typologies at different decision-stages. These decision-stages were defined by the variables perceived drought consequence, coping response efficacy, and behavioural intentions. Decision-stages were identified as contemplative and responsive decision-stages, illustrating willingness and participation in drought coping response at the household level. The importance of applying these psychological paradigms holds value for application in water company market research and policy decision-making in the context of targeted intervention strategies aimed at engendering drought resilient households.

Keywords Drought perceptions · Water efficiency · Drought coping intentions · Drought coping responses · Behaviour typologies

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1 Introduction

Long droughts that result from rainfall deficit in two or more successive winter half years will usually present challenges for water supply in England and the wider UK (Watts et al. 2015). Some of the most notorious droughts in terms of impact include 1893–1898, 1921, 1934, 1959, 1976, 1995, 2006, and 2010–2012. These droughts have affected the UK disproportionately because droughts differ based on scales (spatial and temporal), rainfall patterns, storage capacity, geology, water demand and land use (Dessai and Sims 2010). As such, the hydro-meterological characteristics and range of impacts will vary from one region to another (Cole and Marsh 2006). Of the twentieth century droughts, that of 1976 is perhaps the most significant in terms of impact on water supply for most of England. Since then, strategic drought management has become integral to the planning and management of water resources. Under current drought management policy, private Water Companies must demonstrate their ability to ensure sufficient supply to meet anticipated demand over a minimum 25-year planning period, even when water supplies are stressed (Water 2016). In other words, companies must be able to deliver adequate levels of service during a drought (resilient services). Drought management is hence a high-level affair in the hands of privatised Water Companies, regulators, and farming stakeholders and requires significant capital expenditure in water supply and distribution systems. In this model, the household's role in drought management is reactive to campaigns on the lead up to and during a period of drought or water supply shortfall (as drought is now commonly termed in England) (Water 2016).

Nonetheless, bottom-up approaches such as demand management are also recognised as critical to resilience planning alongside more traditional supply side management representing a paradigm shift. This paradigm shift has been driven by national and European policy change in response to a combination of threats such as increasing population growth, water demand, urbanisation, and climate change (Butler et al. 2017). Population growth, urbanisation, water demand, and climate change are intricately linked to water supply and distribution and hence have implications for drought. Climate change is of interest to this research due to its expected effect on the water cycle and ultimately water supply. Climate models for England show a general trend of hotter and drier summers as well as wetter winters, implying that more severe droughts and floods are to be expected (Watts et al. 2015). A shortage of water supply for domestic and other uses is identified by the UK climate change risk assessment as one of six priority areas requiring urgent action in medium to long-term futures (HM Government 2017). Dimensions of scale are important in meeting these challenges and addressing resilience (Medd and Chappells 2007).

Demand management, which involves the reduction or more efficient use of water, is recognised as a robust, low-regret action for household scale response to the climate challenge (Browne et al. 2013). Demand management strategies may be based on price (tariffs) and non-price approaches (e.g. adoption of water efficient technologies) or a combination of both. Research in demand management has largely focussed on demand forecasting (e.g. Memon and Butler 2006) where micro-components (e.g. volume per use, frequency of use, etc.) of demand are modelled to estimate demand patterns (Browne et al. 2013). In tandem to this, is a growing literature on the sociological and environmental aspects of water use at the household level. Variables typically include attitudinal factors (e.g. pro-environmental attitudes), beliefs, habits, personal capabilities (e.g. knowledge, social status) and contextual factors (e.g. household composition, water pricing) (Russell and Fielding 2010). For instance, Allon and Sofoulis (2006), propose that social and cultural construction of norms and identities shape habits

around water use and hence must be reframed to enable more sustainable use of water. Others found an association between environmental attitudes and intentions to conserve water (Gilg and Barr 2006) and with reduced water consumption (Willis et al. 2011).

These research paradigms often focus on water conservation behaviours in the context of environmental sustainability as opposed to building resilience to drought. Whilst the understanding of sustainable water use is vital for policy makers, it is also important from a policy perspective (national and Water Company) to understand if and how the threat of drought influences the implementation of interventions. This is particularly crucial given the policy shift in English water services to a resilience focus as a response to the extremes the water sector faces. There is now ongoing imperative to better understand water user decision-making to enhance household drought resilience. Hence, a resilience focus is a priority to the current research agenda as opposed to sustainable water use. Currently, there is limited research assessing household water demand or efficiency through a drought resilience lens. In addressing this gap, this paper proposes that an in-depth understanding of the variables underpinning household intentions and behaviours to respond to the threat of drought is required for developing strategies that promote drought resilient futures. Therefore, this research explores household perceptions of drought and drought coping, intentions to implement drought coping responses, and the interactions of social-psychological variables in influencing coping decision-stages. In doing so, this research reflects on a specific system state (resilience of what = households), and a perturbation of interest (resilience to what = drought) (Carpenter et al. 2001) to investigate why coping responses are implemented or not implemented.

The remainder of this paper presents the theoretical framing of the research (2.0), selection of the study areas (3.0), methodology including data collection and analysis (4.0), results highlighting socio-demographics, perceptions, coping behavioural intentions, and decision-stages of drought coping (5.0), and discussion and conclusions (6.0).

2 Theoretical Context

Resilience interventions at the household level are termed as 'coping' throughout this study and refer to demand management or water efficiency strategies used to counter or minimise negative consequences of drought. Whilst studies on household drought coping are rare in the UK, more prevalent studies in Australia and the United States are increasingly using social-psychological frameworks to analyse the relationship between the threat of drought and coping intentions (Mankad et al. 2013; Fielding et al. 2012).

Psychological frameworks such as Protection Motivation Theory (PMT) (Rogers 1975) developed in health research have been widely applied to provide insights into household perceptions and intentions to cope with hazards such as drought. PMT has become a functional tool for assessing human decision-making and behaviour under conditions of risk and uncertainty as reflected by emerging cross-disciplinary application in areas such as climate change (Grothmann and Patt 2005) and water management including flooding (Bubeck et al. 2012) and drought (Mankad et al. 2013). PMT includes two constructs, threat appraisal and coping appraisal (Maddux and Rogers 1983) which makes its application appealing for this research juxtaposed in a resilience setting. Threat appraisal evaluates an individual's perceptions of the likelihood and consequences of a threat and coping appraisal evaluates perceived ability to cope with and avert harm from a threat in an effective way (Grothmann and Patt 2005). Research applying this framework often find that the determinants of an individual's decision

to implement a coping response is, to some extent, related to their perceptions of: 1) the probability and severity of the consequences of a threat; 2) the efficacy and cost of the coping response measure(s); and 3) their capacity to implement the measure. The framing of threats, consequences and coping, forms the basis on which a questionnaire survey was developed. Key questions are presented in Table A (Supplementary Material).

Additionally, socio-demographic variables were incorporated with PMT to embody a social-psychological setting. Socio-demographic factors such as income, age and gender, are often found to be linked to environmental as well as resilient behaviours. A general conclusion is that the economically marginal and politically unempowered tend to have low coping capacity when exposed to a major threat or hazard (Turner 2010). As well as the cultural, behavioural and institutional aspects of water consumption, Randolph and Troy (2008) found that water conservation and demand were related to the socio-demographic composition of households. Similarly, Fielding et al. (2012) found a clear relationship between some socio-demographic variables and household water use. Therefore, several socio-demographic variables were included in the survey to explore their influence on decision-making.

A second framework, Trans-theoretical model (TTM) (Prochaska et al. 1994), was incorporated as a basis for characterising typologies of household decision-stages due to its focus on coping. TTM framework of behaviour change can be used to track adjustments in behaviours over time and in developing interventions for the future as suggested by Pearce et al. (2013). TTM construes change as a process involving progress through a series of six stages (pre-contemplation, contemplation, preparation, action, maintenance, and termination) an individual may face when exposed to a threat (Prochaska et al. 1994). It is expected that only the first three to four stages will be applicable where response to environmental threats is concerned. This is because the stages of maintenance and termination are concerned with cessation of unhealthy behaviour such as smoking, rather than response to a threat.

In the threat-consequence-coping framework in Fig. 1, PMT and TTM have been combined as the underlying theoretical and analytical basis of this research. It shows that, in the context of responding to a threat, individuals pass through different stages which moderate their decisions to implement coping measures. The spectrum of decision stages begins with an individual who responds to drought in a maladaptive way typified by denial and fatalism and are viewed as 'pre-contemplative'. They may also, or later, form intentions to cope with the threat but may not actually implement intended responses illustrating a 'contemplative' decision-stage typified by wishful-thinking and postponement. At the other end of the spectrum are the 'responsives' who are already implementing coping measures and combines action and preparedness from TTM. Decisions are also influenced by wider situational variables (Fig. 1), some of which are investigated here as well.

3 Methodology

3.1 Selection of Study Areas and Sampling

This study focused on the South West of England although it is not an area associated with drought. Instead there is a focus on flooding in the region due to recent incidences of flooding and climate change predictions for increased winter flooding (Environment Agency 2015). Nonetheless, the region, which has been affected by several economic droughts in the past, is hydrologically sensitive to drought due to its dependence on surface water supply and high

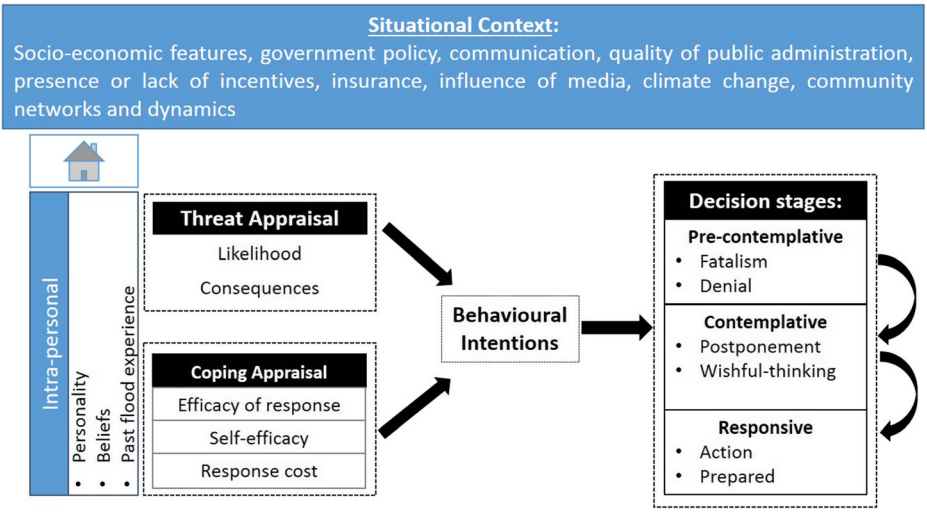

Fig. 1 Theoretical framework of the research. This model combines PMT and TTM in a novel way to investigate perceptions, intentions, and drought coping (adapted from Maddux and Rogers 1983 and Prochaska et al. 1994)

seasonal variations in water demand (e.g. during tourist peaks of summer when rainfall is the lowest) (Phillips and McGregor 1998). Conditions of prolonged water scarcity due to increasingly dry, hot summers and springs are expected to affect the region by the 2080s (Water 2016). Therefore, in addition to flood resilience, drought resilience is a priority for the South West. Our study assessed resilience to both extremes, though only drought coping is reported here. To assess both extremes, we selected two flood-prone communities in Exeter (Fig. 2). The communities being in the same water supply region, have similar drought risk which unlike flooding is not a site-specific hazard, hence flooding was the basis of selection.

The first community, St. Thomas, is an urban community near the centre, whilst the second, Topsham, is located outside of the city (Fig. 2). More details on the demographic and climatic conditions of these areas are provided in the Supplementary Material. The questionnaire

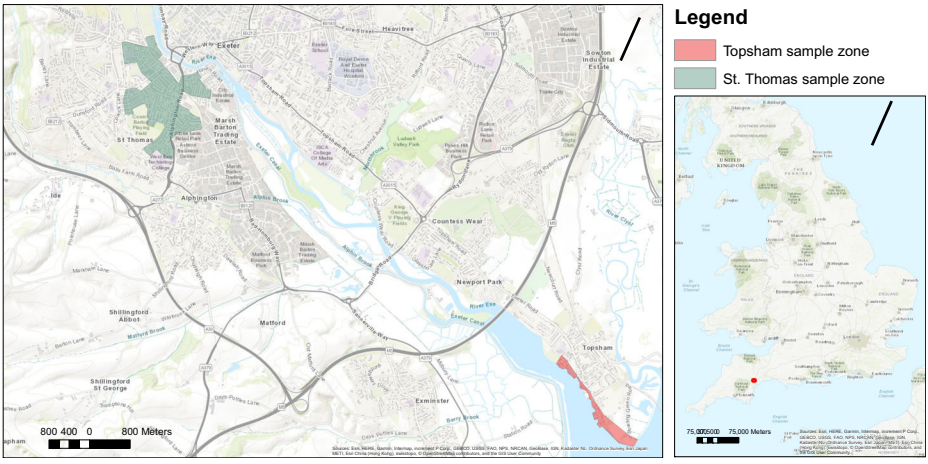

Fig. 2 Location of study areas in Exeter, South West, England

survey was administered randomly in the flood risk areas of the two communities with a total of 250 and 97 households respectively. The response rates were low in both communities, at just over 20%, totalling 91 valid cases for analysis.

3.2 Data Collection

Previous research on PMT in water management have generally employed the use of cross-sectional surveys involving data collection at a single point in time from a sample of the population of interest. This design was used here to document the occurrence of certain characteristics in the population, to make associations between variables, and to be representative so that generalisations could be made about the population. The randomisation of the sample allowed us to meet this condition of making inferences about the population.

The survey consisted of 47 questions of which 15 were directly related to drought. Developed in the framework of PMT, questions placed focus on the threat of drought, the efficacy of response measures to cope with a drought, and capacity of the household to implement the measures (Table A). Socio-demographic variables such as gender, age, education, housing status, and number of occupants were incorporated due to their importance in water demand modelling and water conservation research.

3.3 Analytical Approach

The analytical approach involved a two-stage process of: 1) descriptive analyses and; 2) cluster analyses. Each of the core aspects of PMT were analysed in a descriptive fashion to provide an overview of the perceptions and intentions regarding drought and drought coping. A similarly detailed description of perceptions and intentions regarding drought has not been presented for any location the UK to date and specifically not for South West residents. A summary of the descriptive statistics is found in Table B and correlation of key variables in Table C (Supplementary Material).

The second phase of analysis used clustering algorithms via the R platform (R Core Team 2015) to provide a typology for households where drought coping is concerned. Despite its usefulness in several exploratory pattern-analysis, grouping, decision-making, and machine-learning situations, cluster analysis has some challenges (Jain et al. 1999). Three of the main challenges identified by Jain et al. (1999) are that: 1) all clustering algorithms will produce clusters from a given dataset whether or not there are legitimate clusters; 2) if the data does contain clusters, some clustering algorithms may obtain 'better' clusters than others which may be attributed to the order in which the data are entered into the model; and 3) input variables directly affects finding, characterising, and validating the optimal cluster solution.

Due to the robustness of the *k*-means algorithms in clustering similar cases (individual participants), this method of clustering was selected. This method optimises the clustering of cases by means of an iterative relocation algorithm (Fraley and Raftery 1998). In each iteration, the algorithm allows cases to be moved around so they can be clustered in the optimum position by reducing the within-group sums of squares versus being locked in with the first similar case as in hierarchical clustering (Everitt and Dunn 2001). Since the value of k is not known, the NbClust package (Charrad et al. 2014) in R was used to determine the optimal number of clusters. This function uses 30 of the most validated clustering indices (e.g. Gap Statistic, Silhouette of Cohesion, etc.) to propose the optimal cluster structure based on varying all

combinations of number of clusters, distance measures, and clustering methods from each index (Charrad et al. 2014).

4 Results

4.1 Socio-Demographic Profile

Participants comprised 56% females and 44% males. A majority of the participants (55%) were 55 years and older with females dominating the 55–64 age group and males the 65–74 age group. Older participants lived in predominantly two-person households consistent with the 2011 census for the study areas (Office for National Statistics 2011). Younger households comprised an average of three occupants perhaps indicating families with children and shared households. Participants were living in the communities for various numbers of years ranging from less than one year to over 50 years with the mean period being 20 years. As expected, older participants had, on average, lived longest in the communities although some older participants moved into the communities in recent years.

In terms of education, up to 56% of participants had a combination of undergraduate and postgraduate education qualifications (or their equivalents). Of the remainder, 38% had a mix of secondary school level qualifications (GCSE, A Levels and BTEC) and vocational level qualifications. Only 6% reported having no formal qualifications. Generally, participants in younger age groups had higher levels of educational qualifications compared to older participants. The majority (>70%) of participants owned their home with ownership significantly increasing with age ($r = 0.41$; $p < .01$). With regard to income, the average ranged from £15,000–£34,999 per household per annum. One third of participants preferred not to indicate their annual household income category, limiting the validity of testing its influence on decision-stages. Socio-demographic variables did not have significant correlations with coping intentions (Table C Supplementary Material).

4.2 Drought Experience

Approximately 70% of the participants had never experienced a drought since living at their current address in Exeter. Of those who had experienced a drought, 60% perceived the past droughts to have been of low severity, while the remaining 40% perceived them to be of medium severity. In addition to the droughts experienced at their current addresses, 32% of participants had experienced a drought whilst living at a previous location. Households hence had limited experience or history of drought. When asked what an acceptable period is to be without water supply, the bulk of the participants (63%) indicated only a few days up to a week, 22% no loss of services, and 15% accepting a few weeks to a few months. There was no significant correlation with coping intentions ($r = 0.20$, $p = .12$).

4.3 Perceived Likelihood and Consequences of Drought

Most participants (76%) believed that a major drought would have a low to very low likelihood of affecting their local areas whilst the remainder perceived medium to high likelihood. Mankad et al. (2013) found similarly low perception of the likelihood of a major drought amongst participants in South-east Queensland, Australia, despite being affected by

the recent millennium drought. In both cases, this perception of low drought probability in countries where drought is historically 'normal', is perhaps linked to the reliability of water services where there has been significant economic and technological investment in securing and maintaining water supply.

Consequences associated with drought were perceived to range from very low to medium. The highest consequences were viewed as those to the local area (M = 2.26; SD = 0.88), followed by health (M = 2.20; SD = 0.96), property (M = 2.08; SD = 0.73) and family (M = 2.03; SD = 0.85). Perceived drought likelihood and consequences were significantly correlated to each other ($r = 3.0$, $p < .05$) but not with intentions. Where drought and climate change were concerned, Fig. 3 shows that at least one third of participants neither disagreed nor agreed about climate change affecting drought likelihood and consequences compared with the consensus that it would increase flooding, temperatures, and sea levels. This corresponds with previous research which suggests that UK residents are more likely to associate climate change with flooding compared to other hazards (Taylor et al. 2014). Older people and males were less likely to agree that climate change might impact drought whilst those with higher education were more likely to agree (Table C).

4.4 Perceived Efficacy and Behavioural Intentions towards Drought Coping Measures

The proposed water efficiency measures as household coping responses to drought or water supply shortfalls, were of three categories: 1) water storage; 2) water conservation and; 3): alternative water use. Water storage methods included measures such as simply storing water at home for use in times when there are mains water supply failures and storing rainwater via a water butt for certain end uses. Water conservation measures included adhering to a hosepipe ban, installing water saving devices and taking shorter showers. Alternative water includes non-traditional sources of water such as non-potable reuse of grey (water from washing machines, etc.) or recycled water supplied by a Water Company. The three categories represent different strategies for achieving water efficiency and are measures of scale where coping with drought is concerned. They can therefore scale up from the household to the local area and to the catchment scale, each with its own level of contribution to overall water efficiency. It

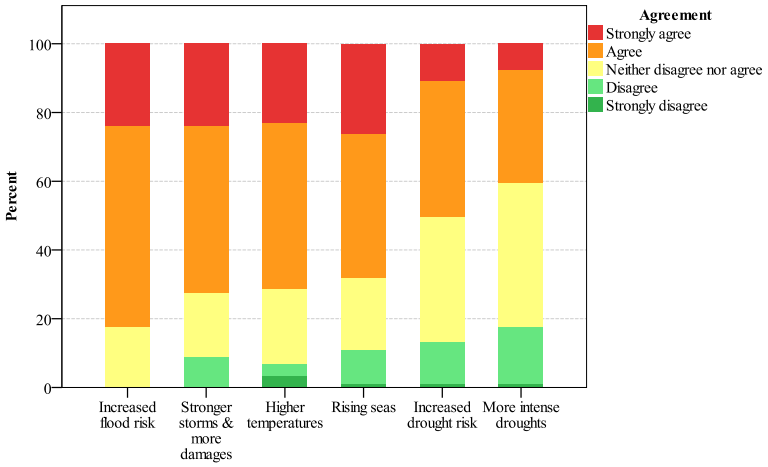

Fig. 3 Comparison of the perceptions of climate change on several weather variables ($n = 91$)

should be noted that although participants were already implementing some of the measures, they were not necessarily doing so to cope with a drought. Fig. A (Supplementary Material) shows the implementation of each measure.

4.4.1 Water Storage

Water butts were perceived as one of the most effective measures to cope with a drought (Fig. 4), (M = 4.03; SD = 0.10). However, only 38% of participants indicated that they were already using water butts (for non-potable purposes) while 40% indicated that they plan to implement the measure. The remaining were either uncertain or had no intention to implement them. As per Chappells et al. (2011), water butts and other forms of rainwater collection are a longstanding feature of British gardens which have recently acquired new significance due to concerns over climate change and peak demand associated with garden watering.

Storing water at home to cope with a drought had a mean effectiveness of 3.60. In terms of intentions, 31% of households were already storing water at home while 22% planned to. The remaining participants were either undecided or had no intentions of storing water at home. This of course is strongly linked to the system of provision where supply interruption is quite rare due to reliability.

4.4.2 Water Conservation Measures

Adherence to a hosepipe ban is a reactive drought response measure usually issued by Water Companies and represents the main drought consequence experienced by English households (Bell 2009). The hosepipe ban was also perceived as an effective drought coping measure (Fig. 3) (M = 3.75, SD = 0.98). Approximately 50% of participants indicated that they were already adhering to a hosepipe ban. They perhaps meant that they had done so in the past. The majority (45%) of the remaining were planning to implement this measure indicating high willingness. Cross tabulation analysis shows that most of the participants (>70%) with high intentions

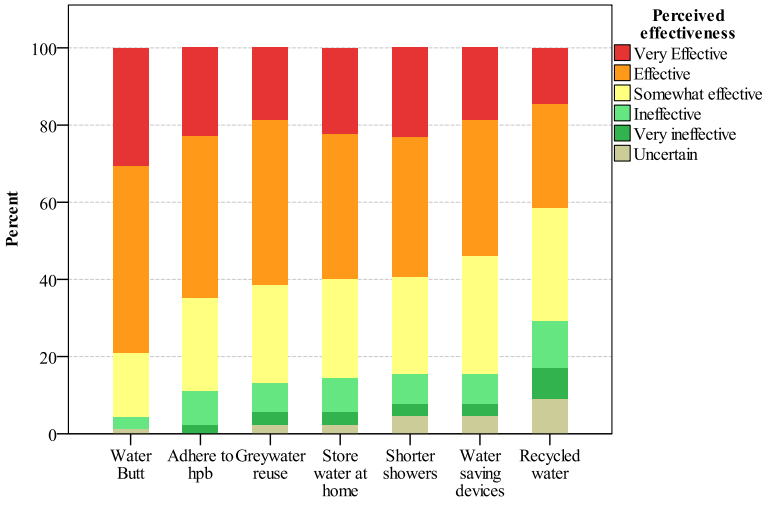

Fig. 4 Perceived efficacy of drought coping measures (hpb = hosepipe ban) (n = 91)

regarding adherence to a hosepipe ban correspondingly considered it an effective drought response measure (Table D, Supplementary Material).

The installation of water saving devices was perceived as an effective coping measure (M = 3.45, SD = 1.23). These measures minimise the flow of water when applied to showers, faucets, and toilets. Regardless, only 35% of the participants had already installed water saving devices. The remaining majority are planning to (37%) or undecided (24%), and just 3% did not plan to install them.

It was found that 50% of participants were already taking shorter showers, a practice that may be linked to a need for lower water bills in a region where the water rate per capita is amongst the highest in the UK. South West customers spend above 3% and 5% of their income on water and sewerage bills respectively compared to the England and Wales average of 1.6% (Ofwat 2011) and hence it is possible that the need for lower water and sewerage bills is the driver for shorter showers amongst participants. In addition, environmental values and the need for greater sustainability may also be drivers for some households although no significant correlation was found ($r = 0.01$; $p = .99$).

4.4.3 Alternative Water Use

The reuse of grey water from showers and laundry as a drought coping measure was perceived to be amongst the most effective measures (Fig. 4), with a mean of 3.59. It was surprising that 22% of participants were already using this type of water (possibly for gardening purposes). One reason being that access to these grey waters is often restricted by the inflexible nature of existing infrastructure serving as a barrier to implementation as found by Hurlimann (2011). Hence, the household must have made some adaptations in order to access this water. Another reason is that of social acceptance. It has been found that social issues such as fear of being perceived negatively, can often undermine willingness to make use of this alternative source of water (Ward et al. 2012).

The drought coping measure viewed as least effective amongst participants was that of use of recycled water supplied by a Water Company (Fig. 4) (M = 3.01; SD = 1.50). Even though recycled water is not currently a source of water that is supplied by Water Companies in England, this was included as a viable means of coping with a major drought as seen during the Australian millennium drought (Turner et al. 2016). The use of recycled water was unsurprisingly the measure with most uncertainty amongst participants (49%). As with grey water reuse, recycled water has several perceptual issues that limit people's willingness for uptake. Willingness may also depend on the nature of end use of recycled water with acceptability decreasing as use becomes more personal (Hurlimann et al. 2009). It is noteworthy that more participants were willing to use recycled water in the future than unwilling (37% versus 14%).

4.5 Self-Efficacy and Response Cost

Assessment of self-efficacy consisted of perceptions of being limited in implementing drought coping responses through a lack of abilities, knowledge, and awareness. There was high agreement that these were all limiting factors with lack of awareness regarded as the most limiting factor (M = 2.21; SD = 1.10) followed by lack of knowledge (M = 2.23; SD = 1.00). There was less agreement (M = 2.60; SD = 1.21) that lack of skills was

a limiting factor. Self-efficacy was not significantly correlated with behavioural intentions ($r = -0.01$; $p = .90$).

Response costs were assessed based on level of agreement that money and time and effort were considered limitations to implementing drought coping measures. It was inconclusive whether money was a limiting factor as responses were closely distributed between the agreement (40%) and disagreement (36%) ranges of the scale and the others neither agreed nor disagreed. The patterns were similar for time and effort but with a small majority agreeing. As response costs increased, behavioural intentions decreased showing significant negative correlation ($r = -0.35$; $p < .01$).

4.6 Other Motivational Variables

Where motivational variables related to social networks were concerned, 48% of participants did not agree that they would increase their uptake of water efficiency measures in response to drought based on the actions of their neighbours. Only 27% agreed that this would further motivate them whilst the remainder neither agreed nor disagreed. Most participants (63%) agreed that being seriously affected by a drought in the future would further motivate them to act. In contrast, changes within the socio-technical system of drought management such as provision of incentives or subsidies and legal requirements, had high agreement (> 60%). The importance of subsidies in water efficiency is highlighted by Memon and Butler (2006) who reckoned lack of subsidies and high costs were the reasons for low uptake of water efficiency measures in UK households compared to other developed countries. Correspondingly, our research finds that there is a significant positive correlation between provision of incentives and subsidies and behavioural intentions ($r = 0.27$; $p < .05$). However, uptake is still low despite the regional Water Company offering a free water saving kit to each household. Hence, it is probable that there is both low awareness about the offer and a perceptual risk of a free offer.

4.7 Typology of Behaviours for Household Drought Coping

Cluster analysis was used to determine if there were typologies of behaviours that could be explained by stage changes. This was an area of research that was identified by Pearce et al. (2013) as lacking in the research agenda with respect to drought and water use behaviours in the UK. PMT variables that were significantly correlated with behavioural intentions (response efficacy and cost) as well as consequences and past experience (based on literature) were used as input variables. The results showed that 12 out of 26 clustering indices recommended a two-cluster solution as optimal. Socio-demographic variables did not form valid clusters.

A Mann-Whitney U test was used to test the validity of the two clusters as seen in Table 1. Clusters formed from PMT variables presented two significantly distinct typologies at different decision-stages. Cluster 1 was termed “contemplative actors” and cluster 2 as “responsive actors” (Fig. 5). These two clusters were distinguished based on significant differences in perceived efficacy and cost of water efficiency measures, and drought consequences (Table 1), illustrating two distinct sets of actors. They therefore also differed significantly in their behavioural intentions towards the implementation of water efficiency measures for drought coping (Table 1). Self-efficacy variables showed no significant difference between the two clusters (Table 1), implying that it may not be an influential factor here. Variables such as gender, age, income, education, home ownership, and occupancy, as well as incentives for

Table 1 Differences between two participant clusters (contemplative actors and responsive actors) developed using PMT variables as inputs

	Drought likelihood	Drought consequences	Response efficacy	Self-efficacy	Response cost	Past drought experience	Behavioural intentions
Mann-Whitney U	914.00	693.50	639.00	980.50	111.50	861.50	349.50
Z	−0.36	−2.54	−2.98	−0.22	−7.31	−1.28	−5.31
Asymp. Sig. (2-tailed)	.72	**.01**	**.00**	.90	**.00**	.20	**.00**

Text in bold refers to those variables that show significant differences across the two custers

drought coping, past experience, and belief in sustainable water use did not show any significant differences between the two clusters ($p > .05$) (Table 2).

4.7.1 Cluster 1 - Contemplatives

Participants comprising cluster 1 were identified as 'contemplatives'. Overall, they were uncertain of the need to implement water efficiency measures for drought coping, but they were also not completely against it, hence the classification as contemplative. They made up the smaller of the two groups with 38 participants or 42% of the sample. Whilst contemplatives had only implemented a few of the measures, they indicated willingness to implement all the measures (M = 2.43; SD = 0.52) (Table E Supplementary Material). Nonetheless, at least one third of the group were also uncertain about implementing some of the measures.

The contemplatives had very limited experience with drought both at their current and previous addresses respectively (M = 0.61; SD = 0.82). They perceived drought likelihood and consequences in their local area to be low (M = 1.90; SD = 0.62 for both) illustrating a low threat appraisal of drought. The lack of recent experience with drought as well as negative consequences of drought in the local area were probably responsible for this appraisal. Bubeck et al. (2012) concluded that severe consequences from previous flood experience was a leading mediating factor in households' willingness to implement coping measures.

With regard to coping appraisal, the situation was more complex. Self-efficacy variables such as knowledge, awareness and abilities/skills did not pose major limitations for this group unlike the potential costs (time and effort and money) of implementing the measures (M =

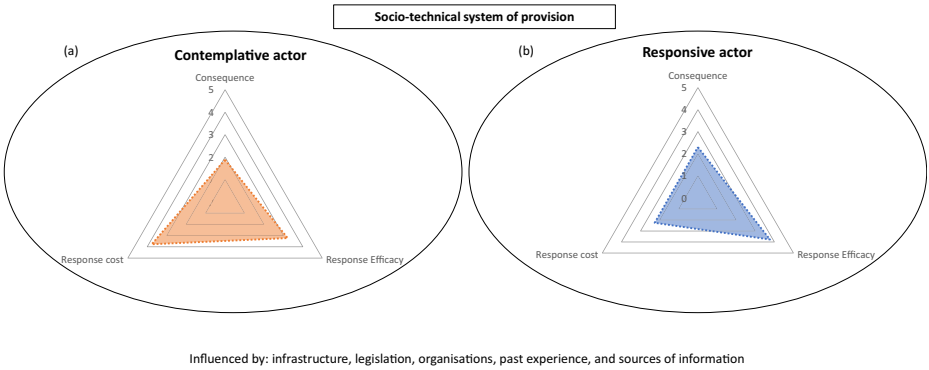

Fig. 5 Characteristics of: **a** cluster 1 (contemplative actors); and **b** cluster 2 (Responsive actors) within the socio-technical system of provision

Table 2 Socio-demographic variables did not show any significant difference across the two PMT clusters

	Gender	Age	Housing status	Occupancy	Income	Education	Subsidies	Past drought experience	Belief in sustainable water use practices	Drought and climate change
Mann-Whitney U	893.00	953.00	916.50	806.50	432.00	821.500	788.00	861.500	925.500	865.00
Z	−.90	−.08	−.11	−.64	−.37	−1.32	−1.22	−1.30	−.60	−1.18
Asymp. Sig. (2-tailed)	.40	.94	.91	.52	.71	.20	.22	.20	.57	.24

3.76; SD = .75). Efficacy of response measures were perceived as low to moderately effective (M = 3.22; SD = .60). Contemplatives were hence characterised by their perceptions of low drought consequences, low-moderate efficacy of response measures, and the limits of costs (Fig. 5).

The combination of these variables perhaps formed important barriers towards their implementation of drought coping responses – they were prepared to contemplate coping responses but have not actively implemented. These psychological variables therefore combine to frame a contemplative decision-stage with regard to drought as a threat. There were no significant findings related to socio-demographic variables (Fig. B Supplementary Material) or other motivational variables such as the presence of subsidies or being affected by a future drought.

4.7.2 Cluster 2 - Responsive Actors

Cluster 2 members were identified as 'responsive actors' and consisted of 53 participants (58%). The members of this group were either already implementing the measures or were planning to implement them (M = 3.10; SD = 0.42 – Table F Supplementary Material), hence their label as responsive actors. They were characterised by medium-high perceived response efficacy (M = 3.80; SD = 0.60), low agreement of cost limitations (M = 2.30; SD = 0.60), and low perceived drought consequences (M = 2.30; SD = 0.70) (Fig. 5). Responsive actors were hence significantly different from contemplatives based on these indicator variables (Table 1).

In addition to higher drought experience (M = 0.90; SD = 1.03), responsive actors also had higher mean perception of drought likelihood (M = 2.16 compared with M = 1.89 for contemplatives) although the two were not significantly different in this respect (U = 914.00, z = −0.36, p = .72). Despite low perceptions of drought consequences throughout the sample, this group expected consequences to be low-medium and were significantly different to the contemplatives in this respect (Table 1). Hence, their drought threat appraisal was higher than the contemplatives'.

Perceptions of drought coping response efficacy was higher than the contemplatives' (M = 3.80; SD = 0.60). Therefore, they had significantly higher perceived coping response efficacy (U = 639.00, z = −2.98, p < .000). The members of this cluster did not expect response cost, both in terms of the financial costs and the time and effort needed to implement the measures, to be a limiting factor to drought coping implementation which was significantly different from cluster 1 (U = 111.50, z = −7.31, p < .000). Self-efficacy variables displayed similar patterns to those of the contemplatives and as such the two were not significantly different (U = 980.50, z = −0.22, p = .90). Based on response efficacy and cost, responsives had somewhat higher coping appraisal than contemplatives. Like the contemplatives, their behaviours and intentions were not affected by socio-demographic variables (Fig. B Supplementary Material).

5 Discussion and Conclusions

Social variables were less constructive to intentions and decision-stages as opposed to the psychological variables of PMT. This is likely related to the participants as actors co-existing in the same system of provision (adequate infrastructure for water supply and distribution, organisations to manage, monitor, operate and maintain the systems, and legislation to ensure adequate water quantity and quality). This system of provision also serves to minimise their

experience with negative consequences of drought. Whilst we did not find a significant correlation between past drought experience and behavioural intentions, perhaps due to the small sample, it was shown that there is potentially an important link between the two. Responsive actors who had experienced drought in the past were already or more willing to implement drought coping measures possibly because of the consequences experienced as one third of these reported past droughts as being medium severity. If the event was consequential, then the household is more aware and willing to counter these negative consequences into the future. Therefore, threat appraisal can be influenced by wider situational variables such as the nature of a past experience or reports of previous droughts (e.g. family, friends, media. This relationship between past drought experience and intentions to implement coping measures has not been as widely explored as in the case of flooding and is an area that requires future detailed research attention.

The framework applied here illustrate that household water users are at different stages in their decision-making with regard to drought coping due to a combination of not only their perception of the likelihood consequences of drought, but also based on the effectiveness and the costs of the coping responses. Their decision-stages are hence strongly influenced by their perceptions of certain key variables linked with their threat and coping appraisals of drought. The differences displayed by the actors in each cluster indicate that their perceptions and behavioural intentions were perhaps developing over time and within their current water governance situation. With limited recent experience of drought and drought not being an imminent threat in Exeter, and the rest of the South West, households are generally not yet at a stage where they will readily implement water efficiency measures on their own. Drought resilience is not seen as an urgent priority and the connections between drought and climate change are poorly understood highlighting yet another area requiring improved awareness. However, Water Companies, as private profit-making entities, are often wary of the perceptual risk associated with discussing a water scarce future.

In an era where enhancing resilience is now a central component of the water sector, Water Companies and policy makers should be applying similar psychological paradigms in their market research to develop targeted approaches for specific household and customer segments. The framework applied her could be applied to identify and target early adopters of water efficiency presenting the opportunity to commence early, no-regrets household drought resilience before climate change effects are noticed. This is instructive to the overall social and cultural changes that are needed before we descend into the middle of the century where many water related challenges are predicted to emerge. A second and critical reason for this type of research is that it is useful for identifying and targeting those who might be vulnerable based on pricing or their water usage (e.g. if they have a medical condition) in a drought. This is particularly important in the South West due to both issues with affordability and an aging population. The presence of subsidies and incentives may be encouraging for such groups of customers or households. A final reason for adoption of a similar analytical approach is that it may prove particularly effective to households in drought prone regions where scaled benefits (e.g. catchment wide) may be achieved through water efficiency. The results would be instructive in targeting each group appropriately to improve response. In contrast, in regions like the South West where droughts have not impacted the supply of service at the household level in recent times, there is currently no incentive for households to become 'drought resilient'. Time-based targeting for example may be used to target customers such as contemplatives after a major drought, or a 'near-miss' drought like those of 2010–2012, 2017 and 2018. Despite not being identified in this study, pre-contemplatives, who are expected to be

unengaged with drought and drought coping, may also be targeted in a similar time-based manner. The availability and inclusion of subsidies and incentives should also be showcased based on the timing of events to those at early decision-stages (pre-contemplatives and contemplatives), as a means of increasing uptake of coping measures. It is important that policy-makers consider these variables as they may have significant outcome in terms of long-term water efficiency at the household level.

Whilst the work presented in this paper focuses on household coping with drought independent of the occurrence of an actual drought event, other work to be presented elsewhere (for example as part of the UK's Drought and Water Scarcity Programme), focuses on adaption and coping measures that may have been implemented during a drought. Further work is required however, to examine in detail the efficacy of coping measures in action perhaps during an actual drought event. The methods and findings have taken the research agenda on household drought response a step further from the usual attitude-behaviour tradition to a research framing that identifies and characterises a spectrum of attitudes and behaviours and how they change over time, with experience, and changes in the socio-technical and socio-cultural interactions with water. Furthermore, the methods applied here are replicable and can be applied and expanded more widely to provide detailed data analytics with the potential to inform policy and decision making for a drought resilient future.

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Compliance with Ethical Standards

Conflict of Interest None

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